

Sub E17 a flattened face running perpendicular to the longitudinal axis of the valve and being arranged on the downstream end of the valve closing section downstream from the fixed valve seat; and

D1 a swirl-producing element arranged upstream from the fixed valve seat, wherein:
the flattened face includes a diameter d that is greater than a diameter D of an outlet orifice, and an entry plane of the outlet orifice is arranged such that the entry plane is completely covered by a projection of the flattened face into the entry plane.

D2 Sub E7 19. (Amended) The fuel injector according to claim 12, wherein the valve seat element includes a spray element which includes the outlet orifice and is arranged downstream from the valve seat element, wherein:

the spray element is fixedly connected to the valve seat element.

REMARKS

I. Introduction

Claims 12 to 22 are pending in the present application. In view of the foregoing amendments and the following remarks, it is respectfully submitted that all of the presently pending claims are allowable, and reconsideration is respectfully requested.

II. Objection to the Drawings

The Final Office Action states that “the ‘direct injection of a fuel into a combustion chamber of the internal combustion engine’ recited in claim 12 must be shown or the feature(s) canceled from the claims.” Final Office Action at p. 2. As an initial matter, Applicants note that claim 12 does not include the language indicated above. However, claim 13 recites that “the fuel injector is for a direct injection of a fuel into a combustion chamber of the internal combustion engine.” The Specification states at page 3, lines 23 to 25 that “[t]he electromagnetically operated valve shown in Figure 1 as an example of an embodiment in the form of an injection valve for the fuel injection system of an internal combustion engine” and at page 3, lines 27 to 28 that “[t]his fuel injector is especially suitable as a high-pressure injection valve for direct injection of fuel into the combustion chamber of an internal combustion engine.” Since the fuel injector illustrated in Figure 1 is stated to be suitable as a high-pressure injection valve for direct injection of fuel into the combustion chamber of an internal combustion engine, it is respectfully submitted that at

least Figure 1 adequately illustrates the limitation that “the fuel injector is for a direct injection of a fuel into a combustion chamber of the internal combustion engine” as recited in claim 13. Furthermore, direct injection of fuel into a combustion chamber of an internal combustion engine is a conventional feature of the present invention and therefore need not be illustrated in the Figures. 37 C.F.R. § 1.83(a). Accordingly, it is respectfully submitted that the drawings fully comply with the requirements of 37 C.F.R. § 1.83, and withdrawal of this objection is therefore respectfully requested.

III. Objection to Claim 12

The Final Office Action objects to claim 12 as the clean and marked-up versions of claim 12, as presented in the November 4, 2002 Amendment, are allegedly inconsistent.

Applicants provided an Appendix in the Reply Under 37 C.F.R. 1.116 filed March 21, 2003 which contained a clean copy of claim 12 as amended by the Amendment filed on November 4, 2002. It is believed and respectfully submitted that the clean copy of claim 12 obviated this objection.

IV. Rejection of Claim 19 Under 35 U.S.C. § 112

Claim 19 was rejected under 35 U.S.C. § 112, second paragraph as indefinite for allegedly failing to particularly point out and distinctly claim the subject matter of the invention. The Final Office Action alleges that the limitation “a spray element” in line 2 of claim 19 appears to be a double inclusion of the “valve seat element” recited in claim 11, line 6. The Final Office Action furthermore submits that the specification, on page 8, line 27, discloses “valve seat element 26 is divided again downstream from the valve face 27.” The Final Office Action alleges that although the spray element is designated by reference 67, it appears that spray element is a sub-element of the valve seat element.

Since the Advisory Action does not indicate whether the proposed amendments to claim 19 contained in the previous Reply Under 37 C.F.R. § 1.116 were entered, the present Amendment directs entry of such amendments to claim 19.

Although Applicants do not agree with the merits of the rejection, in order to further prosecution, claim 19 has been amended herein without prejudice to recite that the spray element is a sub- element of the valve seat element. Applicants note with appreciation the indication in the Advisory Action that the foregoing amendments would obviate this

rejection. In view of the foregoing, it is respectfully submitted that claim 19, as amended herein, fully complies with the requirements of 35 U.S.C. § 112. Applicants respectfully request withdrawal of this rejection.

V. Rejection of Claims 12 to 22 Under 35 U.S.C. § 103(a)

Claims 12 to 22 were rejected under 35 U.S.C. § 103(a) as unpatentable over U.S. Patent No. 4,890,794 (“Imafuku et al.”) in view of U.S. Patent No. 5,878,962 (“Shen et al.”) or as unpatentable over U.S. Patent No. 5,996,912 (“Ren et al.”). For the reasons more fully set forth below, Applicants respectfully submit that the combination of Imafuku et al. and Shen et al. does not render obvious claims 12 to 22. Applicants further submit that Ren et al. do not render obvious claims 12 to 22 for the reasons set forth below.

Claim 12 relates to a fuel injector for a fuel injection system of an internal combustion engine. Claim 12 recites that the fuel injector includes an energizable actuating element, a valve needle that is axially movable along a longitudinal axis of a valve, a fixed valve seat, a valve seat element including an orifice following downstream from the fixed valve seat, and a valve closing section arranged on a downstream end of the valve needle and for working together with the fixed valve seat for opening and closing the valve, the fixed valve seat designed on the valve seat element. Claim 12 further recites that the fuel injector includes a flattened face running perpendicular to the longitudinal axis of the valve and being arranged on the downstream end of the valve closing section downstream from the fixed valve seat. Claim 12 also requires a swirl-producing element arranged upstream from the fixed valve seat, the flattened face including a diameter d that is greater than a diameter D of an outlet orifice. Claim 12 has been amended herein without prejudice to recite that an entry plane of the outlet orifice is arranged such that the entry plane is completely covered by a projection of the flattened face into the entry plane. Support for the amendment may be found, for example, in Figures 3 and 5.

The Final Office Action alleges that Imafuku et al. disclose a fuel injector comprising: an energizable actuating element 14, a valve needle 27, a fixed valve seat 48, a valve seat element 9, 55, an orifice 54a, b, a valve closing section 47, a flattened face (downstream end of 45), an outlet orifice (outlet of orifice 54 a, b). The Final Office Action admits that Imafuku et al. do not disclose a swirl-producing element. The Final Office Action alleges that Shen et al. to disclose a swirl-producing element 38, 48 upstream of a fixed valve seat 34.

Imafuku et al. do not disclose, or even suggest, an entry plane of the outlet orifice arranged such that the entry plane is completely covered by a projection of the flattened face. Imafuku et al. allegedly provide a valve needle 27 which ends downstream from a valve seat 48 in a cylindrical tang 45. The cylindrical tang 45 is located at a downstream end of valve needle 27. A cylindrical nozzle body opening 50 is formed between cylindrical nozzle-body 43 and valve seat face 49. The opening allegedly provides a constant cross-section along the length of the tang 45. Col. 3, lines 1 to 5. The cylindrical tang 45 ends above the disk-shaped perforated body 55. Spray-discharge orifices 54a,b are provided in the perforated body 55. Spray-discharge orifices 54a,b are not closed to ensure an unobstructed inflow of fuel into spray-discharge orifices 54a,b by the use of cylindrical tang 45 and the ring gap around the tang 45. The spray-discharge orifices 54a,b are selectively introduced in the perforated body 5 at an offset relative to cylindrical tang 45, without overlap. Fig. 2; col. 4, line 60 to col. 5, line 2. As a consequence, Imafuku et al. do not disclose, or even suggest, an entry plane of the outlet orifice which is arranged such that the entry plane is completely covered by a projection of the flattened face into the entry plane as recited in amended claim 12.

The Final Office Action merely relies on Shen et al. for purporting to disclose a swirl-producing element 38, 48 upstream of a fixed valve seat. Shen et al. do not disclose, or even suggest, a configuration which has an entry plane of the outlet orifice which is arranged such that the entry plane is completely covered by a projection of the flattened face into the entry plane. Shen et al. do not provide a flattened face running perpendicular to the longitudinal axis of the valve and being arranged on the downstream end of the valve closing section. Fig. 2. Shen et al. provide a frustoconical section at the end of a valve needle, and as a consequence, a flat configuration is precluded. Fig. 2.

The purpose of Shen et al. is to provide constantly swirling fuel upstream of an orifice through the use of a “swirler.” Shen et al. require a conical spray pattern which is characterized by a conical sheet of swirling fuel about an axis 66 with substantially only a minor quantity of fuel within the conical sheet of the conical spray pattern. Col. 4, lines 20 to 23. Shen et al. require a smooth transition of radially swirling fuel into a generally shallow conical swirl pattern about seat 34. Col. 4, lines 27 to 31. Shen et al. also state:

In all of these embodiments, it will be appreciated that the swirl pattern afforded by the swirl plate carries through the frustoconical seat when the valve is open, as well as through the orifice in all of its various forms including the vent tubes. This is a result of smooth transitions

made between a tangentially flowing fuel which continues its swirl pattern as it advances axially and is then turned in an angular direction. The lack of sharp corners and protuberances avoids flow turbulence and the smooth transition surfaces afford a continuation of the strong swirl effected by the swirl plate as the fuel passes through the open valve.

Col. 5, lines 23 to 32. Shen et al. therefore require a smooth transition of fluid flow for operability. Without a smooth transition, the apparatus described by Shen et al. would be inoperative and the purpose of the apparatus provided by Shen et al. would be defeated.

The Final Office Action attempts to add the swirl element of Shen et al. to Imafuku et al. Placement of the Shen et al. swirl-producing element 38 in the Imafuku et al. injector would not be performed by a person of ordinary skill in the art as such a placement would not provide a smooth transition and is contrary to the purpose of Shen et al. If the swirl element of Shen et al. could be added to Imafuku et al., and Applicants do not admit that the swirl element can be added successfully, an abrupt transition would occur due to the sharp flat faced bottom face of tang 45. Shen et al. provide for a rounded frustoconical shape to eliminate sharp or abrupt transitions. Addition of the Shen et al. swirl element to Imafuku et al. could not be performed without an abrupt transition as evidenced by the flat face of tang 45 in Imafuku et al. and thus the purpose of the apparatus described in Shen et al. would be defeated. The Final Office Action alleges that the addition of Imafuku et al. and Shen et al. would be attempted by a person of ordinary skill in the art because Shen et al. and Imafuku et al. allegedly relate to fuel injectors. Applicants respectfully submit that in order to combine the two references as proposed by the Final Office Action there must be a specific teaching in the references themselves to do so. Here, there is no such teaching in the references themselves.

On the contrary, Applicants respectfully submit that Shen et al. through its disclosure teaches away from making the proposed combination. Shen et al. provide that the purpose of the “swirler” is to swirl fuel flowing through the orifice when the valve is in an open position. As a result, Shen et al. only provide an injection charge that has a swirl. The present claims, however, provide a configuration in which some of the fuel injected is axially configured, different than the fuel injector and than the stated purpose of Shen et al. As provided in the Specification, where the valve opens fuel flows mostly axially and without a swirl toward outlet orifice 32. Only directly after this pre-stream follows a main stream

formed by fuel which has flowed through swirl element 47 immediately prior to that and therefore has a swirl. Page 7, lines 29 to 32.

Ren et al. do not disclose, or even suggest, a flattened face which includes a diameter d that is greater than a diameter D of the outlet orifice as required in claim 12. Ren et al. provide an end face which has a diameter less than the diameter of the orifice face, a completely opposite configuration than that recited in claim 12. Fig. 2. Ren et al. furthermore require that the diameter of the flat end surface is smaller than the diameter of the underlying orifice of the valve seat. Col. 2, lines 3 to 4. As a result, Ren et al. do not disclose, or even suggest, the features of claim 12. Additionally, the Final Office Action is *expressly* relying on the Specification of the present application in an attempt to provide support for the present rejection. In this regard, the Final Office Action states that “[i]t would have been obvious to a person having ordinary skill in the art at the time of the invention to have optimized the values of d_0 and d_f for desirability dependant on certain applications (applicant’s specification, page 9, line 12).” Final Office Action at p. 5 (emphasis added). Thus, the present rejection is *expressly* and improperly based on hindsight and should be withdrawn for this reason alone. Furthermore, the Final Office Action attempts to provide support for the present rejection based on an alleged similarity between the “outlet orifice diameter d_0 which is greater than the flattened face diameter d_f ” described by Ren et al. and the part of the needle valve illustrated in Figure 6 of the present application and described on page 9, lines 8 to 13 of the Specification of the present application. However, the alleged similarity of the injector nozzle described by Ren et al. and the valve needle end described in the Specification of the present application and illustrated in the Figures of the present application is irrelevant as to patentability of the claims of the present application.

Applicants furthermore submit that Ren et al. do not provide an entry plane of the outlet orifice which is arranged such that the entry plane is completely covered by a projection of the flattened face into the entry plane. As more fully set forth above, Ren et al. provide a flattened face 46, of which a projection does not cover an entry plane of the outlet orifice. Fig. 2. As a result, Ren et al. do not disclose, or even suggest, the features of amended claim 12.

In rejecting a claim under 35 U.S.C. § 103(a), the Examiner bears the initial burden of presenting a *prima facie* case of obviousness. *In re Rijckaert*, 9 F.3d 1531, 1532, 28 U.S.P.Q.2d 1955, 1956 (Fed. Cir. 1993). To establish *prima facie* obviousness, three criteria must be satisfied. First, there must be some suggestion or motivation to modify or

combine reference teachings. *In re Fine*, 837 F.2d 1071, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1988). This teaching or suggestion to make the claimed combination must be found in the prior art and not based on the application disclosure. *In re Vaeck*, 947 F.2d 488, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991). Second, there must be a reasonable expectation of success. *In re Merck & Co., Inc.*, 800 F.2d 1091, 231 U.S.P.Q. 375 (Fed. Cir. 1986). Third, the prior art reference(s) must teach or suggest all of the claim limitations. *In re Royka*, 490 F.2d 981, 180 U.S.P.Q. 580 (C.C.P.A. 1974). As more fully set forth above, it is respectfully submitted that the combination of Imafuku et al. and Shen et al. does not disclose, or even suggest, all of the limitations of claim 12. Applicants further submit that Ren et al. do not disclose, or even suggest, all of the limitations of claim 12. It is therefore respectfully submitted that the combination of Imafuku et al. and Shen et al. does not render obvious claim 12. Applicants further submit that Ren et al. do not render obvious claim 12.

Moreover, it is respectfully submitted that the cases of *In re Fine*, *supra*, and *In re Jones*, 21 U.S.P.Q.2d 1941 (Fed. Cir. 1992), make plain that the Final Office Action's generalized assertions that it would have been obvious to modify or combine the references do not properly support a § 103 rejection. It is respectfully submitted that those cases make plain that the Final Office Action reflects a subjective "obvious to try" standard, and therefore does not reflect the proper evidence to support an obviousness rejection based on the references relied upon. In particular, the Court in the case of *In re Fine* stated that:

The PTO has the burden under section 103 to establish a *prima facie* case of obviousness. It can satisfy this burden only by showing some objective teaching in the prior art or that knowledge generally available to one of ordinary skill in the art would lead that individual to combine the relevant teachings of the references. This it has not done. . . .

Instead, the Examiner relies on hindsight in reaching his obviousness determination. . . . One cannot use hindsight reconstruction to pick and choose among isolated disclosures in the prior art to deprecate the claimed invention.

In re Fine, 5 U.S.P.Q.2d at 1598 to 1600 (citations omitted; italics in original; emphasis added). Likewise, the Court in the case of *In re Jones* stated that:

Before the PTO may combine the disclosures of two or more prior art references in order to establish *prima facie* obviousness, there must be some suggestion for doing so, found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. . . .

Conspicuously missing from this record is any evidence, other than the PTO's speculation (if it be called evidence) that one of ordinary skill . . . would have been motivated to make the modifications . . . necessary to arrive at the claimed [invention].

In re Jones, 21 U.S.P.Q.2d at 1943, 1944 (citations omitted; italics in original).

That is exactly the case here since it is believed and respectfully submitted that the present Final Office Action offers no evidence whatsoever, but only conclusory hindsight, reconstruction and speculation, which these cases have indicated does not constitute evidence that will support a proper obviousness finding. Unsupported assertions are not evidence as to why a person having ordinary skill in the art would be motivated to modify or combine references to provide the claimed subject matter of the claims to address the problems met thereby. Accordingly, the Office must provide proper evidence of a motivation for modifying or combining the references to provide the claimed subject matter.

More recently, the Federal Circuit in the case of *In re Kotzab* has made plain that even if a claim concerns a “technologically simple concept” -- which is not the case here -- there still must be some finding as to the “specific understanding or principle within the knowledge of a skilled artisan” that would motivate a person having no knowledge of the claimed subject matter to “make the combination in the manner claimed,” stating that:

In this case, the Examiner and the Board fell into the hindsight trap. The idea of a single sensor controlling multiple valves, as opposed to multiple sensors controlling multiple valves, is a technologically simple concept. *With this simple concept in mind, the Patent and Trademark Office found prior art statements that in the abstract appeared to suggest the claimed limitation. But, there was no finding as to the specific understanding or principle within the knowledge of a skilled artisan that would have motivated one with no knowledge of Kotzab's invention to make the combination in the manner claimed.* In light of our holding of the absence of a motivation to combine the teachings in Evans, we conclude that the Board did not make out a proper *prima facie* case of obviousness in rejecting [the] claims . . . under 35 U.S.C. Section 103(a) over Evans.

In re Kotzab, 55 U.S.P.Q.2d 1313, 1318 (Fed. Cir. 2000) (emphasis added). Again, it is believed that there have been no such findings.

Accordingly, there is no evidence that the references relied upon, whether taken alone, combined or modified, would provide the features and benefits of claim 12. It is therefore respectfully submitted that claim 12 is allowable for these reasons.

As for claims 13 to 22, which ultimately depend from claim 12 and therefore include all of the limitations of claim 12, it is respectfully submitted that the combination of Imafuku et al. and Shen et al. does not render obvious these dependent claims for at least the same reasons given above in support of the patentability of claim 12, and it is respectfully submitted that Ren et al. do not render obvious dependent claims 13 to 22 for at least the same reasons given above in support of the patentability of claim 12. *In re Fine, supra* (any dependent claim depending from a non-obvious independent claim is non-obvious).

As further regards claim 14, the Final Office Action's reliance on *In re Boesch*, 617 F.2d 272, 205 U.S.P.Q. 215 (C.C.P.A. 1980) is misplaced. Before the determination of optimal or workable ranges of a variable can be characterized as routine experimentation, a particular parameter must first be recognized as a result-effective variable, *i.e.*, a variable that achieves a recognized result. *In re Antonie*, 559 F.2d 618, 195 U.S.P.Q. 6 (C.C.P.A. 1977). The references relied upon do not even suggest that a ratio of diameters claimed in claim 14 is such a results-effective variable, and the Final Office Action does not even assert that the ratio of diameters constitutes a results-effective variable. It is therefore respectfully submitted that claim 14 is allowable for this additional reason.

VI. Conclusion

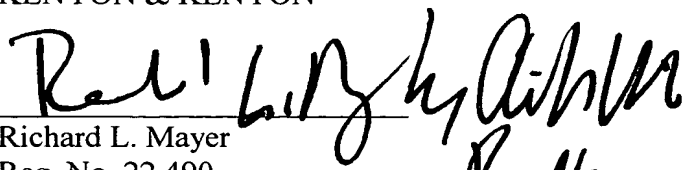
Attached hereto is a marked-up version of the changes made to the claims by the current Amendment. The attached page is captioned, "**Version with Markings to Show Changes Made.**"

In view of the foregoing amendment and remarks, it is respectfully submitted that all pending claims of the present application are now in condition for allowance. Prompt reconsideration and allowance of the present application are therefore earnestly solicited.

Respectfully submitted,

KENYON & KENYON

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Richard L. Mayer
Reg. No. 22,490

One Broadway.
New York, NY 10004
(212) 425-7200 (telephone)
(212) 425-5288 (facsimile)

Reg. No.
42,194

CUSTOMER NO. 26646



26646

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

Claims 12 and 19 have been amended, without prejudice, as follows:

12. (Amended) A fuel injector for a fuel injection system of an internal combustion engine, comprising:

an energizable actuating element;

a valve needle that is axially movable along a longitudinal axis of a valve;

a fixed valve seat;

a valve seat element including an orifice following downstream from the fixed valve seat;

a valve closing section arranged on a downstream end of the valve needle and for working together with the fixed valve seat for opening and closing the valve, wherein:

the fixed valve seat is designed on the valve seat element;

a flattened face running perpendicular to the longitudinal axis of the valve and being arranged on the downstream end of the valve closing section downstream from the fixed valve seat; and

a swirl-producing element arranged upstream from the fixed valve seat, wherein:

the flattened face includes a diameter d that is greater than a diameter D of an outlet orifice, and an entry plane of the outlet orifice is arranged such that the entry plane is completely covered by a projection of the flattened face into the entry plane.

19. (Amended) The fuel injector according to claim [11] 12, [further comprising:] wherein the valve seat element includes a spray element [including the] which includes the outlet orifice and is [being] arranged downstream from the valve seat element, wherein:

the spray element is fixedly connected to the valve seat element.